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The MONTHLY REVIEW

Published Monthly by the

American Electroplaters Society

A SOCIETY FOR THE ADVANCEMENT
OF THE
SCIENCE OF ELECTROPLATING

JUNE, 1925

Entered as second-class matter, September 26, 1922, at the Post Office at Oneida, N. Y., under the Act of August 24, 1912.

Acceptance for mailing at special rate of postage, provided for in section 1103, Act of October 3, 1917, authorized September 26, 1922.

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American
ELECTROPLATERS' SOCIETY

THIRTEENTH ANNUAL CONVENTION

June 29-30, July 1-2

Mount Royal Hotel, Montreal, Canada

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Bring the Ladies. There will be a Program that will please them.

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American Electroplaters' Society

ONEIDA, NEW YORK

Editor's Office, 166 Willow Place, Sherrill, New York

VOL. XII JUNE, 1925 No. 6

PRESIDENT'S—JUNE MESSAGE

To the Membership; Greetings

This being the first month of the New Fiscal Year, I would feel remiss in my duties if I did not again address you. It is with deep appreciation that I come before you at this time for the fine Co-operation that I have had from you all this year, and it is with sincere thanks that I greet you and for the confidence you have reposed in me during my tenure of office as the Supreme President of the American Electroplaters' Society.

My Gratitude to you Supreme Associates, Branch Officers, Committee Chairman, Committee men, and Members, is too great for my powers of Expression.

I also feel that I would be remiss in my duties if I did not at this time say a word of tribute to my worthy assistants on the Firing line i nthe A. E. S. Supreme Secretary-Treasurer Musick and Supreme Editor Mesle for their untiring and unselfish efforts on behalf of the American Electroplaters Society, and their true and tried devotion to our IDEALS.

Few institutions can boast of 1043 members through out the good old United States and Canada, in as unselfish devotion to their profession as can the A. E. S. It is commendable and let us hope that it will continue for time immemorial, and that we may ever prosper and progress and serve in the EDUCATION of our Members and Fellow Plater executives until every man in our profession QUALIFIES to become a member of our SOCIETY, both in the United States and Canada, has become one of US and further propagate this most WONDERFUL INSTITUTION.

As this is start of new year let us all Vow to always

attend our ANNUAL conventions, and help make them greater each year, and ENLIST OURSELVES in the WRITERS to our REVIEW to make it the most VALUABLE paper in our craft for our MEMBERS. Let us most graciously ASSIST the MEN WE select as SUPREME OFFICERS each year to broaden the scope of our SOCIETY by conscientious observance of the laws and promote HARMONY in the interest of ALL of US and to the further SUCCESS of OUR SOCIETY.

Last but not least let us all endeavor to CROWN the efforts of our members in MONTREAL BRANCH and their LOYAL LEADER, Mr. John H. FEELEY, with success by giving them the best ATTENDED and most EDUCATIONAL CONVENTION yet held by the A. E. S. and this also as a courtesy to the PEOPLE of MONTREAL, who so ably seconded these members in their desire to entertain us, and as some OLD PHILOSOPHER has said, "Only as you give, so can you take." This truth, though old and oft repeated is ever new and applies with peculiar FORCE to our UNSELFISH efforts to EDUCATE our CRAFT.

With Best wishes to you all, and a sincere HOPE to Meet you in JUNE at MONTREAL, I am,

SUPREME PRESIDENT,
F. J. HANLON
A. E. S.

CAN YOU USE THIS LETTER

To stimulate Convention attendance the following letter has been sent to over 1600 manufacturers who have plating Departments. We would suggest that platers who have not taken up the matter with their Superintendents, do so, and show him this letter. It may help you to be one of the many platers who will profit for their concern by attending the Montreal Convention of the A. E. S.

St. Louis, June 10, 1925.

Mr. Employer:—

The American Electroplaters' Society is going to hold its Thirteenth Annual Convention in Montreal, Canada on June 29th, 30th and July 1st and 2nd.

There will be educational sessions, mornings, afternoons and evenings, where wonderful discussions will be entered into by the foremost foreman platers of North America on the various plating problems. As you probably know a discussion is always the best part of any paper or lecture and this is especially true with the thorough discussions that are usually the rule at an A. E. S. convention.

We have heard many first class foreman platers say that they would not have missed "that educational session for anything" and "I surely learned a lot from that fellow" etc.

Now then, the big point is this: if a foreman plater spends considerable of his time in the evenings, trying to make himself a better plater by studying modern and efficient methods of handling work, thereby turning out increased production and better plating at a less cost, we feel that he should be encouraged by his employer, where ever possible.

One way to encourage him to continue his efforts is to send him to the A .E. S. Convention. The time and expense will be comparatively small considering the probable benefits to be derived by your company. Quite a few concerns send their superintendents and chemists along every year.

If employers only realized that every effort of the A. E. S., is a direct benefit to them, we would be assured of their heartiest co-operation, in every respect.

Mr. Employer, think it over and we will have a record attendance at the Montreal Convention.

Yours respectfully,
Supreme Society A. E. S.
Per E. J. MUSICK
Sec'y-Treas.

MEET ME IN MONTREAL

June 29-30, July 1-2

A. E. S. CONVENTION

THE MANUFACTURE OF VARNISH AND ENAMELS AND THE METHOD OF APPLICATION

By Mr. H. G. Kettredge

In my opinion the most important material that we use in making any enamel finish is that which is made in the varnish factory, and for a few moments let us consider varnish; and when I say varnish, I mean all of the things that the kettle expert makes.

The word varnish is derived from the name of the beautiful Greek, Berenice, Queen of Cyrene, wife of Ptolemy Eugertes, King of Egypt, about 250 B. C. She is said to have sacrificed her wonderful hair in the temple of Venus in fulfillment of a vow for her husband's safe return from a campaign in Asia. It disappeared from the altar during the night, and was discovered by the astronomer, Conon, as a constellation in the Milky Way. Amber was later likened by the Greeks to Berenice's hair and called by her name. Hence the Latin word Vernix and its later Italian form Vernice, whence our word "Varnish." The German name for amber is Bernstein, or Berenice's stone.

In its popular meaning, varnish is a solution usually transparent or translucent, though occasionally opaque, which, when spread upon a surface in a thin film, dries by the evaporation of its volatile constituents, by the oxidation of other constituents, or partly by evaporation and partly by oxidation, to a continuous, protective coating which may be either highly lustrous or practically devoid of lustre. The transparent and translucent forms of varnish are clearly differentiated, but some of the opaque forms are distinguished from paint only by their composition, the varnish containing resins or gum resins as an essential constituent.

The purpose of varnish is to enhance the beauty of surfaces, to protect them from injury, to increase the lustre or the hardness of other coatings, and, in its technical application, to exclude moisture and gases, vapors and other atmospheric agencies of decomposition or decay, to prevent corrosion, and to reduce friction (as in the loom-harness varnish, bobbin finish, etc.)

So far as we are concerned the preservation of the sur-

faces and the beautifying of the surfaces are of prime importance. Can you imagine the purchase of a hobby horse for your child or an automobile for yourself that has not had the surface both protected and beautified with some varnish or enamel product?

Too often we find in manufacturing plants all of the time necessary taken to produce the article the plant is manufacturing, and the finishing department only the time that is left.

Fortunately more attention is being given to this very important department, and salesmen realize that finish is one of the best talking points in making a sale.

Varnish is composed in a general way of (first) gum to give lustre, oil to give durability, flexibility and flow, and the thinner which makes it possible to spread and also flow.

Of the gums the more important at the present time are Kauri from New Zealand, Manilla and Damar from the East Indies, Congo and Pontianak from Africa, and last, Rosin, which is produced in such large quantities in our own South land. Then we have the black asphaltums, the most common being Gilsonite, which is mined in Utah, and Manjak from the West Indies. Also various pitches; these are made by distilling under a diminished pressure any fat, fatty oil, or grease, the residue when animal oil is used being known as candle tar or stearine pitch, and when vegetable oil is used, takes name of oil as cotton seed or palm oil pitch. These pitches come in almost any degree of hardness. While they are very important raw materials they are liable to make a whole lot of trouble. Another pitch of some interest is a petroleum residue, left in the still after the oils have been driven off.

Of the oils, linseed oil is the most common. The varnish maker, however, does not use much of the commercial raw oil but pays a premium, sometimes as much as eight cents per gallon for a specially refined oil. The best varnish oils are usually refined by alkalies, are pale in color, do not break when heated, and bleach under heat of the kettle.

The varnish maker may buy a linseed oil that has been blown, this oil is made by passing a current of warm air through the oil, this process thickens the oil. Blown oils are very often used to promote flow or leveling.

China Wood oil or Tung oil is probably the most important new raw material that the manufacturer has found in the last 25 years. It is produced from the nut of a tree that grows in China. The oil is obtained from the nut very much the same as linseed oil is obtained from flaxseed. The nut is crushed, the mass heated, and then the oil is pressed out. This is all done in China in the most crude manner.

So important has China Wood oil become that a number of varnish makers have organized the American Tung Oil Corporation which is planting trees in the vicinity of Gainesville, Fla., and hope soon to interest farmers in that vicinity so that we may have an American source of supply.

China Wood oil cannot be used for paint or varnish in its raw state as it dries with a very wrinkled partially opaque film; when heated to 550-575 F it changes to a more or less elastic solid. Rosin, or other oils delay this polmerizing, and this peculiarity of China Wood oil is made use of by the varnish maker; in fact, this is what distinguishes it most prominently from all other oils except Perilla, which polmerizes over 600° F.

Soya Bean oil is an interesting raw material. It is produced in Manchuria. It is treated like linseed oil by refining, blowing, etc., but dries much more slowly.

Perilla oil, also from China and Japan, promises to be a very valuable raw material. One defect it has is its tendency to creep or crawl when spread out on a surface in the raw state. When exposed alongside of linseed oil and under similar conditions it usually dries a little faster than linseed, and outdoor exposure tests give it a rank equal to linseed in this respect.

Menhaden oil is a fish oil produced along our Atlantic seaboard. It is refined and blown. It bodies very slowly in an open kettle, darkening by heat.

It is always necessary to use something in a varnish or enamel to hurry the drying of the oil. This increased drying action is accomplished by adding very small quantities of lead, iron, manganese, or cobalt.

There are three general types of driers:

First—Red lead, litharge, lead acetate, manganese dioxide, manganese borate, prussian blue, basic carbonate of iron and cobalt acetate. These are added

to the hot oil at the proper temperature; a noticeable reaction usually takes place and the metal goes into solution, darkening the oil more or less, depending on the metal used.

Second—Fused soaps of the metals, and linseed oil or rosin, producing very dark compounds.

Third—Precipitated soaps of the metals, and eithor Linseed or China Wood oil or Rosin. These precipitated driers are always much lighter than the fused and are also stronger.

Fused and precipitated driers have the advantage of combining with the oil at a lower temperature than the others, giving a lighter color and allowing the oil or varnish to be used more quickly, as there is no sediment from the drier to settle or be filtered out.

Gum spirits of turpentine is probably the best known thinner. Wood turpentine and pine oil, distilled from pine stumps, is also used more or less, depending on the individual varnish maker. The large oil refining companies have perfected their naphtha and petroleum turpentine substitutes so that they are very reliable and their use makes possible the low prices for varnish and enamels. Kerosene is also used to some extent.

The usual manner of making a gum varnish or japan is to melt the gum, add the oil which may or may not already be treated with the necessary drier, cook the batch to obtain the proper body, then cool and thin. The batch is then filtered and tanked.

When rosin is used instead of gum it must be treated in some way to partially neutralize the acid and harden it. This may be accomplished in several ways: one being to melt the resin, add 4 or 5% of lime, cook until it is combined and then proceed with the varnish; or which is more common, dip the neutralized resin into large shallow pans to cool. It may then be broken up and used as required.

Another way to neutralize this resin acid is by making a resin ester. The organic chemist is familiar with the reaction where an acid and an alcohol are brought together, under proper conditions they combine to form an ester. Resin is melted in a vacuum still, after which the proper

amount of glycerine is added. The water which is formed in this reaction is taken out through the vacuum pump.

Twenty years ago all of the best exterior varnishes were made of the imported hard gums, linseed oil, and thinned with turpentine, and varnish makers viewed with alarm the rapid depletion of the gum fields. Now the most of the exterior varnishes are Resin Ester and China Wood oil, or Resin and China Wood oil, or a blend of this kind of varnish and one made of hard gum.

The viscosity of a varnish is very important to control and in the case of all clear varnishes, except blacks, is comparatively simple.

For making routine determinations of consistency of varnish we use the air bubble test. To make this test a small glass tube about 100 m.m. long and about 13 m.m. in diameter is filled nearly to the top so when the cork is inserted an air bubble is left. When the tube is inverted the bubble rises through the liquid at a definite rate, depending on the size of the bubble and the consistency of the varnish.

We have several sets of twenty standard tubes each filled with mineral oil mixtures which are about half a bubble apart.

The tubes we use are carefully selected as to inside diameter and the tests are all made at approximately the same temperature—70° Fah. It is also very necessary that the bubble in the tube of the varnish to be tested is exactly the same size as the bubble in the standard.

Where pigment goods or black japans are to be tested, the bubble cannot be seen and the viscosimeter must be used.

Color varnishes and enamels are simply the proper colors ground to the last degree of fineness in clear varnishes.

The maker should know, of course, how the material is to be dried, and also how it is to be applied—whether dip, brush or spray. Sometimes a given enamel may be applied in all three ways, but very often this is not the case and special liquids and special pigments must be selected to suit the individual case.

Some of the more common White Pigments are: First, corroded White Lead—this is the Basic Lead Carbonate

formerly made by the Old Dutch Process, but now usually made by quicker methods. Sublimed Lead, which is the basic Sulphate of Lead, Zinc Oxide is also a very valuable white pigment made in two ways, the American Process is by roasting Franklinite or Zincite, zinc bearing ores found in large quantities in New Jersey; the French Process is made by roasting Zinc Spelter.

The two white leads, Corroded and Sublimed and American Process Zinc Oxide are used in house paints.

The French Process Zinc being much whiter than that made by the American Process is used for the finest grades of white enamel.

Lithopone is another white pigment which is being used in very large quantities. It is formed by the double decomposition of Zinc Sulphate and Barium Sulphide forming a molecular combination of Zinc sulphide and Barium Sulphate. Up to within a comparatively few months ago all lithopone was darkened more or less by the actinic rays of the sun. Now as it is being made it is practically light proof. The greatest part of the lithopone produced is used in flat wall paints. It is also used in Mill Whites, enamel undercoats, enamels, etc.

Barytes is Barium Sulphate, is mined in Georgia, Tennessee and Missouri. It is used as an extender and as a base for more expensive colors. A precipitated Barium Sulphate known as Blanc Fixe is also used.

Asbestine is Magnesium Silicate, a fibrous talc, mined in Northern New York. It is used as an extender and also in connection with heavier pigments to prevent hard settling in the package.

Whiting or Calcium Carbonate is used as a base for expensive colors and for putty.

Gypsum or fully hydrated Calcium Sulphate is used as an extender as is also China Clay.

Yellow Ochre is mined in France and is a hydrated ferric oxide and clay. It gets its color of course from the oxide.

Siennas and Umbers are silicates of iron and alumina containing manganic oxide.

The iron reds such as Venetian or Indian Red may be

either natural oresk ground and roasted, or they may be made from Copper as roasted.

The chemical colors are a very interesting list, the more common are, first, Crome Yellows—which are Lead Chromates containing varying amounts of Lead Sulphate.

Zinz Yellow which is Zinc Chromate.

Para reds are the oldest chemical reds. They are made with paranitraniline in hydrochloric acid and Sodium Nitrate by the so-called diazo reaction in the cold and rendered insoluble by acting on it with an alkaline solution of beta napthol. When precipitated pure it is called Para Toner. It may also be precipitated on Barytes, Blanc Fixe or Whiting.

Prussian Blue is Ferris or Ferro cyanide and is precipitated b ythe action of a solution of Sodium or Pottasium Ferro Cyanide and a solution of Ferric Salt BLACK PIGMENTS.

Bone Black is made by calcining bones in a closed vessel in a suitable furnace. In this process an oil is given off, the residue in the vessels is bone black and is used to decolorize sugar, and glycerine and also as a black pigment. The coloring matter is carbon which may be anywhere from ten to twenty per cent of the whole.

Carbon or Gas Black is practically an American monoply. It is made by burning natural gas, usually at or near the gas well, without a sufficient oxygen for complete combustion and allowing the sooty flame to strike a cooled iron cylinder. The soot or carbon black is deposited on the cylinder which revolves and the black is scraped off. Carbon blacks leave no ash when burned and are practically pure carbon.

Ivory Black was originally made from Ivory chips and waste in a manner similar to the one described for bone black. The Ivory Black on the market today is a good grade of bone black made from selected bones.

Lamp Black is made by burning various oils to produce a very smoky flame and then collecting the soot in a system of flues. Very often the black contains traces of unburnt oil which makes it very slow to dry. Lamp Black is usually 93 to 94% carbon, the balance being ash. I recently saw a sign that had been made in about 1857. It had been, I

am told, a white background of some kind probably corroded white lead, and on this white panel were the black letters. The black letters are still perfect but the surrounding white has gone and also some of the wood so that the letters are raised now more than one eighth of an inch. The lasting qualities of these black letters is due no doubt to the only lamp black that was used to make them.

Probably the hardest job of color matching that the technical factory man has is with blacks. There is a popular misunderstanding that all black is just black. The truth is that there is almost an endless variety of shades of black and these may be best seen by comparison. We have one black pigment, a carbon black, which is the blackest pigment in our factory; but when this is ground in clear varnish and compared with some of the same black ground in clear varnish to which a very small percentage of clear asphaltum has been added, the one containing the asphaltum is the blacker. If the asphaltum percentage is increased the condition is reversed; the asphaltum mixture takes on a brown tone and the original carbon black and clear varnish is the blacker.

A few minutes ago I spoke of the fact that when Raw China Wood Oil was allowed to dry it formed a wrinkled partially opaque film. This characteristic of China Wood oil is used to produce the crystal finishes that are used. These are made in two ways. First, a ground color of the proper shade is applied and dried then the coat of clear crystal finish applied. The other way is to combine color and crystal in one coat. The formation of the crystals takes place best in an atmosphere of impure air, in the presence of an open gas or kerosene flame. One way is to have an oven with an open gas flame, after the crystal coating has been applied light the open flame, put the coated articles in the oven and raise the temperature during the next half hour to 150° F. This forms the crystals. The heat may then be raised to 200° or 250° F. and the coating baked.

All are familiar with the application of paint and varnish by hand brushing. Modern industry could not wait for this method of application, so quicker means were discovered. Probably the first was dipping. Here the coating is kept in a tank and the article to be coated is submerged

then hung over a drip board to drain and then dried. One drawback to this method is that while draining the coated article is exposed to dust and does collect more or less, depending on how clean the finishing room is kept. Again if the article being finished is irregular in shape runs and drips are bound to form. Also the surface of the tank is exposed to dust and holds every speck that touches it and it is very often necessary to drain the tank and clean the material.

As the demand for finished articles increased the spraying machines or so-called air brushes were introduced. The earlier ones were very crude, but these have been improved until practically every industry manufacturing articles that have to be finished have one or more.

One of the objections to this method of finishing raised is the amount of material used. There is a waste of course, but sometime ago, a friend gave me some figures that may prove interesting—with one gallon of enamel he could brush by hand 115 of the articles he had to finish, giving each one two coats, or 230 hand brushed coats from a gallon. With a gallon of the same colored enamel he could spray 90 of the same articles, giving each one coat or 90 coats. But the single sprayed coat was equivalent in covering to two brush coats and at the same time it cost him about one-third to spray a coat as it did to brush one so his labor saving was such he could have bought two gallons to spray with and still have been way ahead.

With this method of finishing the work may be coated, put on a covered truck or into the oven away from dust, and any kind of article no mater how irregular it is may be finished in this manner.

Another method of finishing that is applicable to certain classes of work is that where the enamel or varnish is forced through a hose and a suitable nozzle in a stream. This method is common in auto body factories. With a hand brush a stripe is applied the width of the brush around the top of the body, then the enamel or varnish is applied in a stream to the body, washing down dust and bubbles, the excess is caught in suitable drips and is cleaned and returned to the storage. There are two methods of

doing this, one by means of overhead storage tanks and pumps to return the material, the other in a special machine.

Another method of applying finish which is applicable to very small articles is tumbling. Here the articles such as buttons, shoe eyelets, metal tips of shoe laces, etc., are put in a tumbler with exactly the proper amount of enamel and the tumbler allowed to run until all are thoroughly coated. They are then dumped on trays and baked.

The drying of a varnish or enamel, as we have said, is both evaporation and oxidation. Experiments have been made which show that a thin film of linseed oil exposed in a dark chamber at normal temperature will remain wet almost indefinitely. We have this condition in a baking oven, a thin film that must be dried in the dark. The increase in temperature hastens the evaporation and the oxidation both. It is obvious that in order to obtain the best results that the oven must be ventilated properly to remove the volatilized thinner and supply the necessary oxygen to dry the film. When linseed oil dries it takes up about 16% of its weight of oxygen forming a hard elastic non-sticky product called linoxyn.

In any given baking operation you can increase the heat and shorten the time or decrease the heat and increase the time.

As the base oil of the liquids we use ore organic compounds they darken with heat the same as the loaf of bread in the oven; for this reason blacks may be baked at a higher temperature than colors and colors at a higher temperature than white.

The advantages of baking over air drying are obvious. In addition to the saving of time and shop room recent experiments have shown that if we take a given coating, such as a finishing varnish for example, and coat two panels, air drying one and baking the other, the baked panel will out wear the one that has been air dried.

To some people it may seem that the varnish industry has progressed very slowly. This was due to the fact that the practical information was handed down from father to

son, and the practical man was not disposed to tell exactly how he produced the various products.

Twelve or fifteen years ago, I was talking with an acquaintance about one of the most prominent English Varnish Manufacturers and he made this statement: "If the practical varnish maker were to leave his job with this firm, no one else in their employ would be able to tell exactly what they had in their tanks and they would be compelled to depend on some other practical man to duplicate the line for them." This condition existed at one time in this country and may exist now in some few plants; but usually you see now the practical man and the trained chemist working in perfect harmony and by this means alone has the industry progressed.

The Modern varnish plant has its research department where you will find chemists and practical finishers working first to improve the old finishes and also to design new ones.

Very recently a great deal has been said about lacquer coatings for all sorts of articles. There are two general classes of these—one made of cellulose acetate which will not burn readily; and the other of cellulose nitrate which is gun cotton. The acetate on account of the high cost is not used to a great extent.

The general use of the nitrate lacquers was made possible by the discovery of a process for making a cellulose nitrate that would form a thinner solution than regular gun cotton. I have two bottles here, one is a solution of high viscosity cotton of the old type and the other is a solution of the low viscosity cotton. The first has 12 ounces per gallon of solvent, and the second has 24 ounces per gallon of solvent. The first is so heavy it will hardly flow, the 24 oz. solution is quite thin. By the use of the low viscosity cotton a coating of sufficient thickness to afford protection may be applied by spraying. Gums of different kinds are added to increase the lustre, and vegetable oil to increase the elasticity.

Lacquers dry by evaporation and on account of the volitality of the solvents pigments cannot be ground in them in the same manner as varnish or linseed oil. The pigment

must be ground either in a non-volatile portion or in a special mill that prevents evaporation.

I have here some lamp shells coated with typical finishes both high and low bake and lacquers which you may examine at your leisure. To each shell is attached a tag showing the method of application, the number of coats. and the method of drying.

RESUME OF WORK

By Cincinnati Branch

The accompanying articles are a resume of work that has been taken up by Cincinnati Branch, A. E. S., in their laboratory in the Vocational Training School, under auspices of the Board of Education of Cincinnati.

Mr. John Locke, our honorary member, has been very active in compiling the information contained in these sheets.

Respectfully submitted,

WM. J. FLUSING, Secretary,

Cincinnati Branch, A. E. S.

The following article is a brief resume of the work that has been done at the laboratory of the Cincinnati Branch, A. E. S.:

Percentage composition of chemicals: Copper sulphate was the compound used, $CuSO_4 5H_2O$. The molecuelar weight is divided as follows:

Copper Cu=63	63
Sulphur S=32	32
Oxygen O_4=(16x4)	64
Water $5H_2O$=(18x5)	90
Total	249

Then

$$\text{Copper=Cu=}\frac{63}{249}= \quad 25.3\%$$

$$\text{Sulphur S} = \frac{32}{249} = 12.9\%$$

$$\text{Oxygen } O_4 = \frac{64}{249} = 25.7\%$$

$$\text{Water } H_2O = \frac{90}{249} = 36.1\%$$

Equations

A chemical equation is a shorthand method of representing the combination, separation or exchanging of atoms of different chemicals.

By the aid of a balance we can determine that the total weight of chemicals undergoing a reaction is the same after the reaction that it was before. We may have different compounds but the weight of the resulting ones is the same as that of those used.

Again we may find a loss, as in burning a piece of wood, where something escaped into the air, or we may find an increase in weight, as when a piece of iron is rusted, when something is taken from the air. For example: We add copper carbonate ($CuCO_3$) to sodium cyanide (NaCN) copper cyanide and sodium carbonate are formed. If we know the formula for these substances we can express the reaction by an equation and knowing the atomic weights of the different elements we can figure out how much of each substance was used up and how much of the resulting substances was formed thus:

$$CuCO_3 + 2NaCN = Cu(CN)_2 + NaCO_2$$
$$123 + 98 = 115 + 106$$

thus 123 parts of $CuCO_3$ will produce 115 parts $Cu(CN)_2$. Suppose we wish to make copper sulphate from copper and

sulphuric acid, we make use of the atomic weight of the different elements:

$$Cu + 2H_2SO_4 = CuSO_4 + SO_2 + 2H_2O$$

$$63 + 196 = 159$$

This tells us that to make 159 lbs. of copper sulphate requires 63 lbs. of copper and 196 lbs. of sulphuric acid.

Method of Expressing Temperatures

In this country both the centigrade and Fahrenheit thermometers are used, and in view of the fact that most scientific work is based on the centigrade scale, a method of changing from one to the other is necessary. On the centigrade scale the melting point of ice is 0° and the boiling point is 100°, while on the Fahrenheit scale the melting point is 32° and the boiling point 212°.

To change Fahrenheit to centigrade temp. substract 32° from the Fahrenheit and multiply the remainder by $\frac{5}{9}$ — thus 104° F to C.

$$104 - 32 = 72 \times \frac{5}{9} = 40° \text{ C}$$

Change 50° C to F.

$$50° \times \frac{9}{5} = 90 + 32 = 122° \text{ F}$$

Method of Expressing Specific Gravity

There are three methods of expressing the specific gravity or density of solutions. The Beaume (B) scale, the Twaddell (T) scale and the specific gravity (S. G.) scale.

By the specific gravity of a solution we mean the ratio of a certain volume of it to the weight of an equal volume of some other substance taken as a standard. Water at 4°C is usually taken as the standard.

Most hydrometers, however, are graduated for a tem-

perature of 15.5°C(60°F). Thus the specific gravity of a solution is 1.16 (20°). This means that any volume of that solution weighs 1.16 times as much as the same volume of water at (4°C.. It also means that 1 cubic centimeter of the solution weighs 1.16 grams or a liter of the solution weighs 1,160 grams.

Electrical Terms

The rate of flow of electricity through the circuit is called current and is measured in columns per second or amperes. An ampere is that amount of electricity which will deposit under certain conditions a given amount of metal (1.118 mg of silver or 0.328 mg of copper) in one second. The resistance to the flow of electricity through the circuit is measured in ohms. The ohm is defined as the resistance of a column of mercury 106.3 cms long and 1 sq. mm cross section at a temperature of 0°C. The electrical pressure used to force the flow of electricity through the circuit is measured in volts. The volt, therefore, is that electromotive force which will send a current of one ampere through a circuit having a resistance of one ohm.

In 1827 Professor Ohm proved the following relationship existing between voltage ampereage and resistance:

$$\text{Amperes} = \frac{\text{Volts}}{\text{Ohms}}$$

Example: Suppose a current of 6 amperes is flowing through a tank with a resistance of 4 ohms. What is the voltage?

$$\text{Volts} = \text{amperes} \times \text{ohms},$$
$$\text{therefore volts} = 6 \times 4 = 24 \text{ volts}$$

When either copper or nickel is being deposited from an electrotyping solution work is being done inside the electrolyte. The amount done depends upon the condition which can be varied. This change of condition can be measured to a great extent by an application of ohms' law. While it is a very simple one it is the basis of a great many electrical measurements. By an understanding of it we can deduce many interesting facts, one of which is very obvious, namely: an equal current can be produced in a circuit

either by doubling of the voltage or by a decrease in the resistance of one-half.

Electrical work is measured in terms of watts. Now the rate at which work is done depends upon two things: the amount done and the time in which it is done. The energy used up in doing the work is equivalent to the power multiplied by the time. Therefore, the watts used is equivalent to the product of the voltage multiplied by the ampereage or watts=volt×amperes. A watt is defined as the amount of electricity used, when by the use of one volt a current of one ampere passes through a circuit. The watt, however, is a small unit, so the usual commercial unit is the kilowatt, equal to 1,000 watts. The rate at which an engine will do work is expressed in terms of horsepower. One electrical horsepower (E. H. P.) is equivalent to 746 watts, and vice versa, one kilowatt (K. W.) is equivalent to 1.34 horsepower. By resistance we mean the opposition set up in the circuit to the passage of the current. This resistance comes from two sources, the leads and connections (external resistance) and the electrolyte (internal resistance). The external resistance is easily reduced to a minimum by using leads of sufficient size and the keeping of all contacts clean and tight. If the leads or connections become heated it is time to inspect them, for this heating is due to unnecessary resistance. The internal resistance is reduced by the introduction of substances having a high degree of conductivity, or a raising of the temperature or by varying the distance between anode and cathode. Working on a large scale, however, slight variations in the cathode surface do not affect the current density appreciably. Still, we should always bear in mind that to obtain the best possible results in every way, our anode and cathode surface should be approximately the same. An observance of this rule is the greatest asset in the maintenance of solutions. Some substances are good conductors, consequently they offer little resistance to a current of electricity. The resistivity of different substances vary to a great extent. Silver and copper are the best conductors; in other words, they offer the least resistance.

Pure water is a very poor conductor, its resistance being

about 15,000,000,000 times as much as either silver or copper. Relative powers of some of the metals for conductance of an electric current are given in the following:

Silver	100
Copper	100
Gold	78
Zinc	28
Iron	17
Nickel	13
Lead	8

An increase in temperature also increases the resistance of most metals, although the increase in resistance is not the same for all of them. For illustration, copper increases slightly more than silver and nickel about 50% more than copper.

BRANCH NEWS

New York Branch

The New York Branch of the A. E. Society meets every second and fourth Friday of each month in the World Building, Park Row, N. Y. City. Secretary-Treasurer, John E. Sterling, 468 Grand Ave., L. I. City, N. Y.

Pres. Wililam Fisher presided at the May meetings of New York Branch of the A. E. S. The meetings were exceptionally well attended. The meetings were mainly devoted to the nomination and elction of officers for the ensuing year. Delegates and Alternates for the coming Montreal Convention were also elected. The following are the officers elected: President, William Fisher; Vice President, F. Houshalter; Secretary-Treasurer, John E. Sterling; Recording Sect'y, E. Tannart; Librarian, Philip Morningstar; Sarg.-at-arms, B. Nadel; Ass't. Sarg.-at arms, H. Rhuhlmann; Trustees, T. Haddow, Franklyn J. MacStocker, Jos. Minges; Delegates to Montreal Convention, William Fisher, John E. Sterling, Franklyn J. MacStocker; Alternates, Philip Morningstar, Jos. Downs, F. Houshalter. The application of Mr. G. Simmons was received and referred to the Board of Trustees. Mr. T. A. Gardner of N. Y. Branch read a paper in which he gave a description of preparing and plating aluminum die castings and enthusiastic discussion followed. A vote of thanks was tendered to Mr. Gardner for his interesting paper.

Toronto Branch

Owing to Victoria Day being observed on May 25th, which was our date for regular meeting, the meeting was held on Friday evening, May 29th, and the attendance filled the room nearly to its capacity. An unusually large amount of business was dealt with and the following officers were eleected unanimously: President, Mr. Colin E. Turner; Vice President, Mr. John Walker; Secretary-Treasurer, Mr. W. S. Barrows; Librarian, Mr. Charles Kemish; Door Attendant, Mr. J. Young. Plans were completed for reception of western delegates who may stop over in Toronto, June 27th, enroute to Montreal. Mr. Barrows and Mr. J. S. Cairus were chosen as delegates to the convention. Mr. John Acheson, Mr. Thomas O'Keefe and Mr. Joseph Ellis were chosen as trustees.

Newark Branch

At our last meeing on June 5 last the following officers were installed: Mr. George Reuter, president; Mr. G. W. Onkson, vice-president; Mr. F. W. Matts, secretary-treasurer; Mr. Sam Taylor, librarian; Mr. Oliver Sizelove, Mr. Phil Sievering and Mr. W. Hults, trustees; Mr. Frank Dressel, sergeant-at-arms.

The installation was conducted by our new member by transfer from Hartford Branch, George B. Hogaboom. Our branch is very fortunate in having the ever popular George B. H. on the list of membership.

The hot wave that gripped nearly the entire country did not evade Newark, so our meeting was brief. We did stay through long enough to elect one member, receive an application and suspend six delinquents.

Philadelphia Branch

Monthly meeting of Philadelphia Branch was held June 5 at the U. of Pennsylvania, with the president, Geo. Gehling, presiding. Owing to the extreme heat the session was very brief. Mr. Graham gave a short talk on "P. H. Indicators." Application of M. Dumsha, 5015 Melrose street, Philadelphia, was received and referred to the board of trustees.

A committee was appointed to arrange for outing during August.

No meeting will be held in July and August.

Hartford-Connecticut Valley Branch

Hartford-Connecticut Valley Branch met on May 25 at the Hartford Engineers' Club. Vice-President Kennedy presided, and there was an attendance of thirteen members.

The following have been elected officers of this branch for the coming year: President, James A. Bagshaw; vice-president, W. J. R. Kennedy; secretary-treasurer, Tennant Elwin; librarian, H. R. MacFadyen; board of managers, H. M. Roberts, G. E. Vibberts, George A. Dix; delegates to convention, W. J. R. Kennedy; Tennant Elwin, W. T. Jordan; alternates, G. E. Vibberts, H. R. MacFadyen, M. Mosesian.

Detroit Branch

Regular meeting held at D. E. S. Clubhouse, 478 W. Alexandrine, with an attendance of 20 members, including past regular officers in charge of meeting. Secretary's report read and approved; also treasurer's report read and approved.

Officers for ensuing year were installed by Let-George-Do-It Kutzen and were as follows: President, Charles Cunningham; vice-president, Charles Metzger; secretary-treasurer, Elmer W. Woodmansee; librarian, A. J. Fritz; board of managers, Lewis, Gesser, Phillips; delegates to convention, Shepard, Cunningham, Fritz; alternates, Lovering, Phillips, Gesser. Meeting adjourned at 10:30 p. m.

ELECTED TO MEMBERSHIP

St. Louis Branch

R. C. Kells, active .....2328 Virginia Ave., St. Louis, Mo.
R. S. Hutton, Assoc.
c|o British Non-Ferrous Metal Research Assn., Birmingham, England

Detroit Branch

Edw. Ritter .....3741 Maxwell Ave., Detroit, Mich.
Edw. Gesser .....7915 E. Lafayette Ave., Detroit, Mich.
C. J. Haeberby .....5975 Woodward Ave., Detroit
Wm. Graves .....C|O Packard Motor Car Co., Detroit

Newark Branch

Edward J. Schorr, Active .....613 East Jersey St., Elizabeth, N. J.

Philadelphia Branch

Carlton Smith, Active .....Halboro, Pa.
P. Runeknabe, Active .....3665 N. 5th St., Philadelphia
L. Sherman, Active .....1833 N. Franklin St., Philadelphia

APPLICATIONS RECEIVED

New York Branch

Geo. Dubpernell, Assoc. .....654 Bergen St., Jersey City, N. J.
Geo. Simmons

Newark Branch

Thomas Anthony Dondi, Active.....267 Tittleton Ave., Newark, N. J.
W. J. Patterson

LOST BY DEATH

Chicago Branch

Geo. R. Langer .....2439 Lexinton Ave., Chicago, Ill.

Newark Branch

DeWitt Moore .....14 Hinsdale Pl., Newark, N. J.